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PENSOFT

Occurrence of *Euterpe edulis* Mart. (Arecaceae) in Atlantic Forest fragments in southern Brazil

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Abstract

We report new occurrence records of *Euterpe edulis* Mart. and compare them to a database of known occurrences data available in online repositories. The new records are from an Atlantic Forest fragment in São José do Capinzal village, municipality of Chapecó, Santa Catarina, Brazil. We found 1,393 occurrence records in the online database, of which 491 are unique records primarily from within the Atlantic Forest remnants. We also present photographs, distribution maps, and ecological characterizations that may be useful for future studies.

Keywords

Deciduous Seasonal Forest, Palmito-juçara, threatened palm

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Introduction

Euterpe edulis Mart. (Arecaceae), also known as Palmito-juçara, is a monopodial palm with a slender and straight cylindrical stem that reaches 8–30 cm in diameter in adult individuals (Elias et al. 2018). Adult individuals of *E. edulis* have a dense crown composed of 15–20 large leaves with each leaves up to 3 m long and trunks ranging from 20 to 30 m tall (Henderson et al. 1995). The inflorescence is infra foliar with a 50–70 cm long spadix and flowers in triads (one female and two male) in the rachillae (Mantovani and Morellato 2000). Fruits are globose drupes, 1.0–1.4 cm in diameter, with a thin green (immature fruits) or purple (mature fruits) fibrous epicarp and a woody endocarp containing a single seed (Queiroz 2000). This species has a single apical meristem representing the point of vegetative growth. Therefore, heart-of-palm harvesting practices remove the apical meristem, with the implication that the plant dies (Henderson et al. 1995; Galetti and Aleixo 1998).

The historical range of this palm encompasses Atlantic Forest areas, mostly in southern and eastern Brazil,

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Figure 1. *Euterpe edulis* Mart. exsiccate made from plant material collected in the São José do Capinzal village, municipality of Chapecó, Santa Catarina, Brazil. **A.** Proximal part of the leaf. **B.** Distal part of the leaf. **C.** Inflorescence and fruits in the maturation phase. Exsiccate is deposited in the herbarium of the Universidade Regional de Blumenau (http://furb.jbrj.gov.br) under code FURB66272.

Argentina, and Paraguay (Galetti and Fernandez 1998). Currently, *E. edulis* can be found at low densities, mainly in Atlantic Forest remnants along the coast of Brazil, Argentina, and Paraguay and in some Cerrado gallery forests on the Center-West Region of Brazil (Soares et al. 2014; Elias et al. 2018). It occurs in the understory of the rainforest from the sea level to 1400 m (Henderson et al. 1995). It is generally restricted to forested areas, possibly due to greater humidity and lower solar radiation there than in open areas (Gatti et al. 2014).

Once considered a hyper-dominant species throughout is geographic range, illegal heart-of-palm harvesting and human-driven habitat loss and fragmentation have negatively affected the density of *E. edulis* (Muler et al. 2014). Therefore, it is now considered a threatened species, categorized as Vulnerable according to the National Centre for Flora Conservation Red List (CNCFlora 2012). In addition to the expected loss of intraspecific variation, population reduction may also impact other species interacting with this keystone species. More specifically, its flowers are pollinated by several insects (Dorneles et al. 2013), and its fruits are consumed and dispersed by the local avifauna (Reis and Kageyama 2000; da Silva and dos Reis 2019) and fruits and seeds on the ground are consumed by small mammals (Genini et al. 2009). Additionally, its apical meristem and seedlings are part of the diet of several mammals (Taira et al. 2002; Silva 2010). Finally, *E. edulis* fruits and apical meristem play an important economic role in human communities. The fruit's pulp has a highly appreciated taste and flavor, and the apical meristem is considered a genuinely Brazilian delicacy (Sgroi Pupo 2007; Barroso et al. 2010).

Here, we present georeferenced occurrence records of *E. edulis* in an Atlantic Rainforest remnant in São José do Capinzal village, municipality of Chapecó, Santa Catarina state, southwestern Brazil.

Methods

From January to July 2020, occurrences of *Euterpe edulis* were recorded using a GPS device during technical visits to small ranches and farms on the banks of the Uruguay River. During the fieldwork, about 20 km were surveyed, from the district of Goio-ên to the mouth of the river Irani in São José do Capinzal village. Whenever an individual was located, we took photographs and recorded its geographic coordinates. Plant material (leaf and fruit) was collected from one individual and transported to the Herbarium of the Community University of the Chapecó Region (Unochapecó). We identified the

Figure 2. New records of *Euterpe edulis* Mart. in the São José do Capinzal village, municipality of Chapecó, Santa Catarina, Brazil. **A.** Adult individuals with inflorescences during the reproductive phase. **B.** Juvenile individuals with clumped distribution. **C.** Bird feces with *E. edulis* seeds.

material based on vegetative parts, inflorescences, and fruits using two taxonomic keys for the Arecaceae family (Reis 2006; Soares et al. 2014) and with the support of a botanist at Unochapecó. A duplicate of the vegetative material was also sent to the Universidade Regional de Blumenau (FURB). We confirmed the identification with specialists. Photographs of the FURB voucher material are available for consultation at http://furb.jbrj.gov.br under the code FURB66272 (Fig. 1).

We assess the distribution of *E. edulis* using the Global Biodiversity Information Facility (GBIF; http://www.gbif.org/) and speciesLink (https://specieslink.net/) databases. Altogether, these databases include data for a large number of herbaria (https://www.gbif.org/grscicoll/collection/search; https://specieslink.net/col/). The final dataset was filtered by excluding the records with geographical issues (fall outside the South or Central America and geographical coordinates of 0° longitude and 0° latitude) and duplicate records. Later, we obtained the linear distance from each record to the new records using the GeoDistanceInMetresMatrix function (https://eurekastatistics.com/calculating-a-distance-matrix-for-geographic-points-using-r/) in R-Program (R Core Team 2019). We created maps for the compiled occurrence records using QGIS v. 3.16.2.

Results

Euterpe edulis Mart.

Figures 1, 2

New records. BRAZIL – **Santa Catarina** • Chapecó, São José do Capinzal village; 27°15′43″S, 052°40′53″W; 330 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°15′31″S, 052°40′51″W; 330 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°15′06″S, 052°40′58″W; 400 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°14′12″S, 052°40′32″W; 390 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli leg.; exsiccate, FURB66272 and Unochapecó #4901; 27°14′12″S, 052°40′24″W; 370 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°14′05″S, 052°39′48″W; 320 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°13′57″S, 052°39′32″W; 360 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°13′44″S, 052°39′30″W; 460 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°15′19″S, 052°36′10″W; 350 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°14′29″S, 052°35′34″W; 370 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°14′16″S, 052°35′09″W; 310 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°14′15″S,

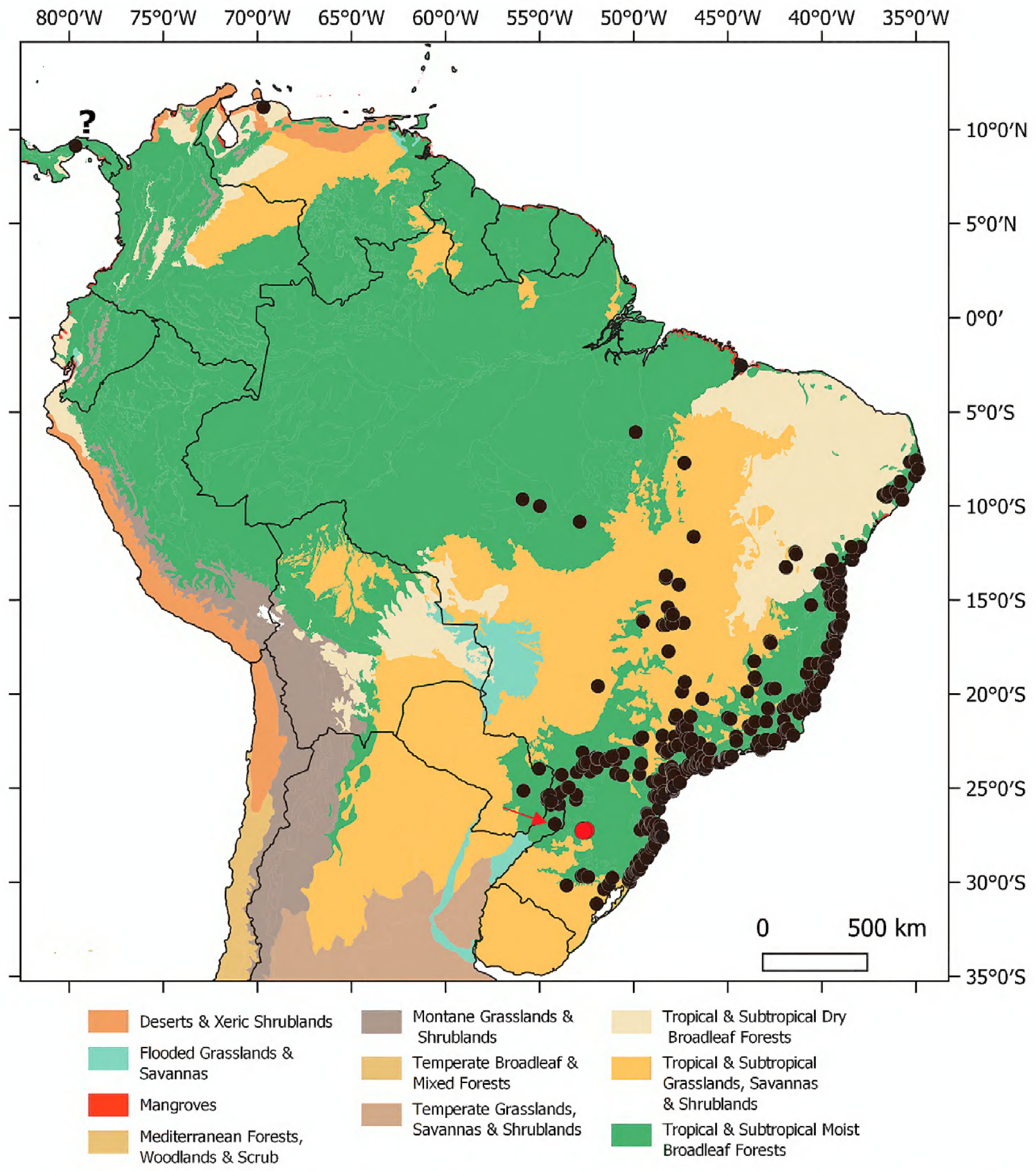

Figure 3. *Euterpe edulis* Mart. distribution. New occurrence records are represented by red dots and those from online repositories by black dots. The red arrow indicates the closest georeferenced occurrence record from the new ones. The question mark indicates the occurrence record from Panama. Biome classification follows Dinerstein et al. (2017).

052°32′46″W; 300 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°13′38″S, 052°32′34″W; 300 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.; 27°16′34″S, 052°41′39″W; 430 m alt; 21.VII.2020; M.T. Szczygel and T.J. Zandavalli obs.

Identification. We identified plants using two taxonomic keys for the Arecaceae family: Reis (2006) following steps 1, 6, and 8; and Soares et al. (2014) following the steps 1′, 3′, 4, and 5. Both taxonomic keys led to the palm species *E. edulis* (Fig. 1).

Distribution. Our new records were all found in São José do Capinzal village, municipality of Chapecó, near the right bank of the Uruguay River (Figs. 3, 4), in Deciduous Seasonal Forest in remnants of the Atlantic Rainforest biome. We found *E. edulis* concentrated in the understory of the forest remnants, with few adult individuals, some young individuals, and many clustered seedlings (Fig. 2).

We found 404 georeferenced occurrence records of *E. edulis* in the GBIF database (https://doi.org/10.15468/dl.3c3ynv) and 989 in speciesLink. From the total, 491

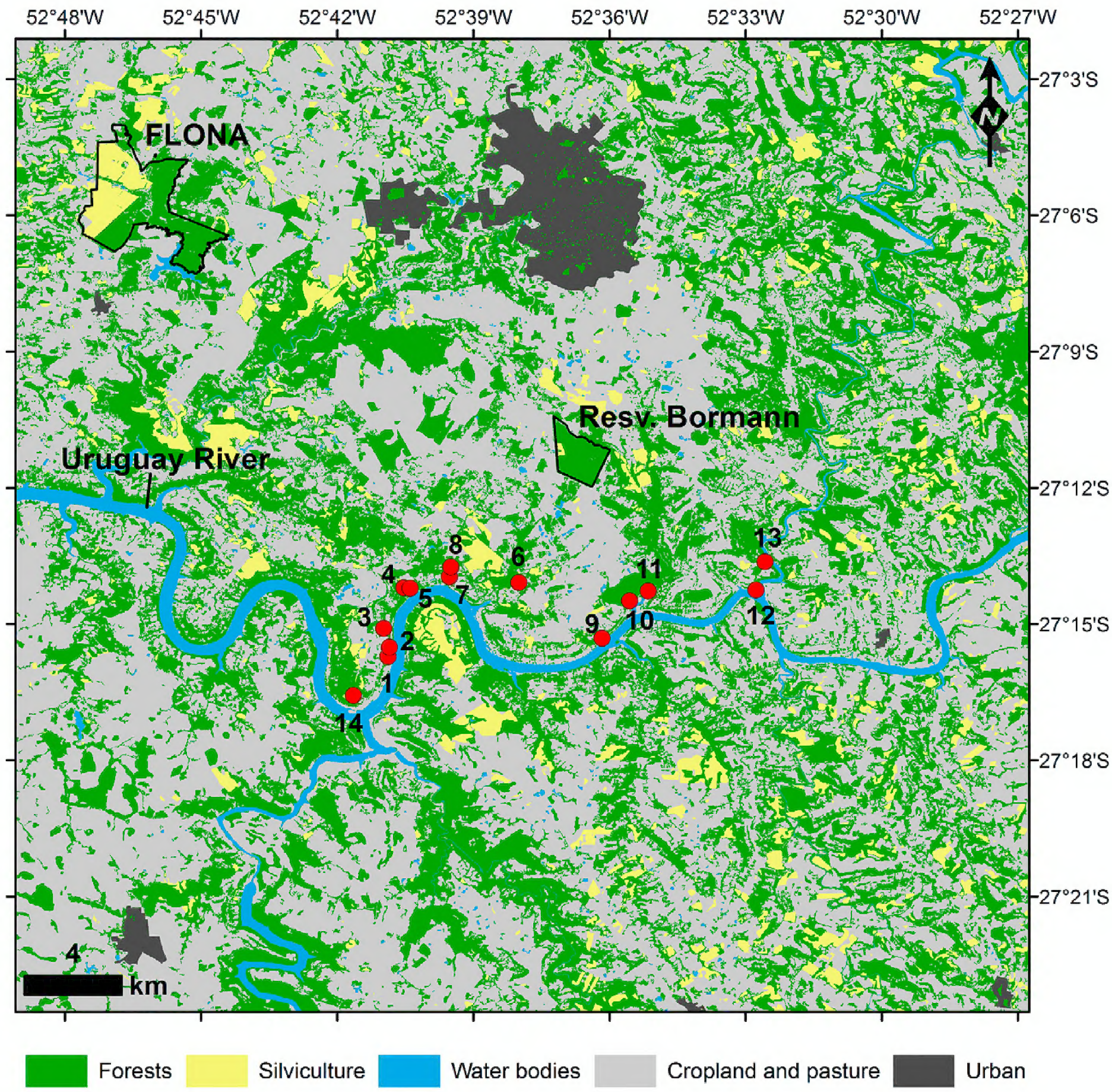

Figure 4. The new occurrence records for *Euterpe edulis* Mart. in the municipality of Chapecó, Santa Catarina, Brazil. Land use and land occupation followed the Brazilian Foundation for Sustainable Development (http://geo.fbds.org.br/). Bormann Reserve and IBAMA Forest (FLONA) are two conservation units closely located to the new records (http://mapas.mma.gov.br/i3geo/datadownload.htm#). The number accompanying each point corresponds to the order of appearance of each record in the "New records" section.

records were unique after data filtering (Fig. 4), and they were generally associated with Atlantic Forest remnants (Figs. 3, 4). Based on the georeferenced dataset, the nearest occurrence record, located in the province of Missiones, Argentina (GBIF #416925661; indicated by a red arrow in Fig. 3), is 156 km from our new records.

Discussion

The occurrence records of *Euterpe edulis* reported here are all from Atlantic Forest remnants in the municipality of Chapecó, close to the right bank of the Uruguay River. Permanent conservation areas, such as in riparian forests, are essential for conserving this threatened palm. The Atlantic Rainforest biome is one of the most fragmented forests in Santa Catarina and one of the least known and studied in the southern region of Brazil (Grasel et al. 2017). In the literature, *E. edulis* has been recorded in small, sparse habitat patches along the upper Uruguay River watershed (Klein 1972; Reitz 1974; Soares et al. 2014; Elias et al. 2018). More specifically, *E. edulis* was reported in the left bank of Uruguay River in northwestern Rio Grande do Sul (Soares et al. 2014). In Santa Catarina, this species was reported from the Uruguay watershed in the 1920s, but no individuals were detected in later surveys (Reitz 1974; Elias et al. 2018), and the current literature considers this species extirpated in this region (CNCFlora 2012; Elias et al. 2018). Thus, our new records from the Uruguay River watershed in Santa Catarina are central for preserving *E. edulis* populations in this region.

Most of the occurrence records of this species are

from Brazil, and only a few are from Argentina and Paraguay. Generally, most records are from Atlantic Forest remnants, but a few are from Cerrado gallery forests and the ecotone of the Amazon Rainforest–Cerrado biomes. Records from this ecotone (i.e., GBIF ID 1090662137 and 1090661778) were found in flooded forests and gallery forests.

Records from Venezuela and Panama (Fig 4.) are far outside the expected distribution of *E. edulis*. The Venezuelan record is available for consultation in the Missouri Botanical Garden (http://www.tropicos.org/Specimen/100549546). It is a single palm specimen found in forest path in a savanna area, and its identification was confirmed by specialists. On the other hand, the Panama record (GBIF ID 1563574227) should be better investigated. It lacks essential information, such as the locality where it was observed, voucher number, and collection and collector names.

In the databases, the relatively small number of unique records highlights the negative impact of rapid deforestation of the Atlantic Forest (Ribeiro et al. 2009) and the overexploitation of *E. edulis* for human consumption (Muler et al. 2014).

The nearest georeferenced occurrence record from our new data is 156 km distant in Misiones, Argentina. Additionally, there are occurrences of this species from northwestern Rio Grande do Sul also has distribution records (Soares et al. 2014). Considering that *E. edulis* is a primarily zoochorous species (Cazassa et al. 2016, Silva et al. 2017), northwestern Rio Grande do Sul or Misiones may be source populations for the (re)colonization in the area of our study. An alternative hypothesis is that recolonization was from the seed bank in the soil. Indeed, the literature indicates historical records in western Santa Catarina dating to the 1920s (Klein 1972; Reitz 1974). However, *E. edulis* seeds have a short viability (Andrade 2001), and it is therefore unlikely that the recolonization was from the local seed bank. The hypothesis that *E. edulis* was introduced by the community is also unlikely, as farmers have claimed that the species has been present in the region for some years and deny that there was any planting effort. The sampled individuals of *E. edulis* are concentrated in the understory of the forest remnants, with few adult individuals, some young individuals, and many clustered seedlings. The described pattern may be explained by the low seedling survival in the understory due to excessive shading (Ribeiro et al. 2011), thus making it challenging to establish populations. Its local dispersion seems zoochorous, as evidenced by seeds in bird feces found in the study area.

Species distribution models indicate that 66% of the Atlantic Forest area would be suitable for the occurrence of *E. edulis* (de Souza and Prevedello 2019). However, most of this climatically suitable area has been deforested (Ribeiro et al. 2009). Therefore, only about 12% of the estimated area may contain climatically suitable fragments for *E. edulis*. Also, the effects of forest fragmentation on the populations of *E. edulis* may lead to a severe reduction in the seed bank and the gene flow between the remaining populations (Nodari and Fantini 2000; Seoane 2007). Accordingly, considering the dramatic losses in suitable habitats across the original distribution of *E. edulis* and its overexploitation, our study describes an area that should be prioritized in future conservation and restoration efforts of this threatened species.

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